THE INSTITUTE OF PHYSICS
47 BELGRAVE SQUARE, LONDON, S.W.1.

BULLETIN

No. 56 AUGUST, 1954

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The Bulletin is not intended for general circulation : your copy should not therefore be passed to a library.

LECTURES IN BIOPHYSICS AND MEDICAL PHYSICS

Part-time courses of post-graduate lectures in **biophysics** and **medical physics** will be given in the physics department of the Royal Cancer Hospital, London, S.W.3, during the session 1954/5, starting 4th October, 1954. Particulars can be obtained on application to the Director of the Physics Department, Institute of Cancer Research, Royal Cancer Hospital, Fulham Road, S.W. 3.

APPOINTMENTS VACANT

The inclusion of particulars of a vacancy must not be taken to imply that the Institute necessarily approves of the terms offered or that might be offered. Candidates should satisfy themselves that these are satisfactory, and they may always refer to the Institute for advice.

Applications are invited by the **Electrical Research Association** from **graduates** in Physics, Engineering, Mathematics or Physical Chemistry for fundamental and applied research in various applications of electricity. Starting salaries are from £475 to £600 p.a. for those without post-graduate qualifications or from £600 to £800 p.a. for those with higher qualifications. Appointments are eligible for superannuation under the F.S.S.U. Application should be made to the Director, E. R. A. Laboratory, 5 Wadsworth Road, Greenford, Middlesex.

Young **graduate** in physics having completed National Service, required in electronics section of **Hadfields Limited Research Laboratory.** The post involves physical testing in connection with the development of special steels and alloys and the design and development of apparatus for such work. Experience in electronics is not essential, but would be of advantage. Apply stating age and details of training and experience to date to The Personnel Manager, Hadfields Limited, East Hecla Works, Vulcan Road, Sheffield, 9.

British Electricity Authority, London Division, Third Assistant Engineer (Communication Section), Technical Department, Divisional Headquarters.

Applications are invited for this position based at Westminster, S.W.1. The section is responsible for the construction, testing and maintenance of a private communications system owned and maintained by the Authority, using line, teleprinter and radio equipment and techniques. Previous experience on this class of apparatus is essential, and telephone manufacturer's works experience desirable. The Engineer appointed will be directly responsible to the Communications Engineer and deputise for him in his absence. Preference will be given to candidates educated to University degree standard, preferably in physics or light current electrical engineering and with administrative experience. Commencing salary in range £801 3s. to £943 19s. 0d., with ultimate progression to £1,053 p.a., including London Allowance, in accordance with N.J.B. Agreement, Schedule C, Class AX/EX, Grade 4. The post is superannuable. Applications, quoting Vacancy Number 54/587, may be made on form obtainable from Divisional Secretary, British Electricity Authority, London Division, Generation House, Great Portland Street, W.1, and be received by August 24.

The British Cotton Industry Research Association

There are the following vacancies at the Shirley Institute for honours graduates and graduates with higher degrees.—(1) A **physicist** or **mechanical engineer** to undertake fundamental and applied research on certain mechanical processes employed in textile finishing. (2) A **physicist** or **textile technologist** for fundamental and technical researches in the process of doubling, which consists essentially of the twisting together of yarns. The successful candidate will be required to interest himself in the technical needs of the industry and, under guidance, to develop his researches accordingly. Industrial experience, not necessarily in the textile industry, is desirable. (3) A **physicist** or **research engineer** for research on weaving machinery. Knowledge of experimental stress analysis is desirable.

For the first of these appointments applications are invited from those doing National Service, from students taking degrees in 1954 and from people who expect to be available at some time before the end of 1954. Men with post-graduate experience will also be considered for this post. Posts 2 and 3 are more senior and some post-graduate experience is essential. The starting salaries are £500 to £550 for inexperienced graduates and up to £900 may be paid to more senior men. All posts carry superannuation benefits under the Federated Superannuation System for Universities.

Apply, giving full particulars, to The Director, Shirley Institute, Didsbury, Manchester, 20.

Nelson Research Laboratories, The English Electric Company Limited, Stafford, have a vacancy for a graduate or equivalent in applied science or technology. The post will include both fundamental and development work on the processing and use of materials in high vacua. Applicants should have an interest in or previous experience of materials technology. Reply quoting Ref. 1336A to Department C.P.S., 336/7 Strand, W.C.2.

Graduate physicist required for appointment as assistant in textile testing department. Experience of textile testing not essential, but candidates should have a sound knowledge of classical physics. Age 25–30 years. Salary according to age and qualifications. Superannuation under F.S.S.U. Apply to the Secretary, British Rayon Research Association, Heald Green Laboratories, Wythenshawe, Manchester.

(*Continued on page iii*)

THE INSTITUTE OF PHYSICS

No. 56 BULLETIN AUGUST, 1954

THOMAS YOUNG, M.D., F.R.S. (1773–1829)*

By FRANK OLDHAM, M.A., B.Sc., F.Inst.P.
(*Headmaster, Hinckley Grammar School.*)

Thomas Young was both a scientist and a philosopher. By the range and nature of his intellectual interests, by the methods of exposition he employed, Dr. Young belongs to the eighteenth century ; by the discoveries which he made known in the early years of the nineteenth century he is a link between the eminent scientists of his own age and those of our own.

Dr. Thomas Young was born at Milverton, near Taunton, on the June 13, 1773, of Quaker stock. To his parents' example and training he owed much, for he says " The principles which I imbibed and the habits which I formed under the guidance of these dear and excellent relatives have more or less determined my character in future life, whatever it may be." Dignified, serious, somewhat reticent, he had the power of application to study to an unusual degree and he had a horror of wasting time. From earliest years he showed himself to be unusually precocious. He read fluently at two years of age and by four years had read the Bible twice through and Watts's hymns. He repeated from memory Goldsmith's " Deserted Village " to his grandfather, before he was five. The study of classics he began at a very early age and after four years (1782–86) at a school at Compton in Dorsetshire, where he gained much by his friendship with the usher, Mr. Jeffrey, he came under the influence of a private tutor, John Hodgkin. The latter had been appointed by a wealthy Quaker merchant, David Barclay, to be tutor to his grandson, Hudson Gurney, who was about two years Young's junior. A lifelong friendship grew from the association of Gurney with Young and from the letters they wrote to each other we have been able to gain an insight into Young's character and discoveries. By the age of nineteen, Young had not only acquired a profound knowledge of the classics, Hebrew, French, German, Italian and the grammar of such languages as Chaldee, Syriac, Persian, but he had also mastered Newton's works, those of Lavoisier, current continental mathematics and was also widely read in natural history and could construct his own apparatus. As Sir Joseph Larmor stated : " Was it the very universality of Young's range

* Based on a lecture given to the Institute's Education Group on March 15, 1954.

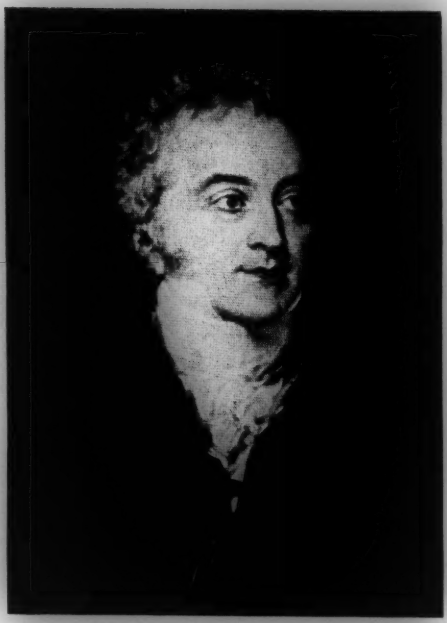

Fig. 1. Portrait of Young by Sir Thomas Lawrence, engraved by G. R. Ward. (From "Life of Thomas Young," by George Peacock)

of interests that saved him from premature mental exhaustion ?" Young's uncle was the well-known Dr. Brocklesbury (1722–97) of London, and it was through his influence that he decided to become a doctor, and so entered the training school of St. Bartholomew's Hospital in 1792. His uncle was friendly with Burke, Porson, Baum, Dinsdale, Hunter, and Young quickly came to their notice for his amazing talents. At this time the Duke of Richmond, one of his uncle's patients, offered Young the post of his private secretary, but this was declined. The Duke must have had a profound effect on Young, since, after a year in London, he transferred to Edinburgh University. Here again he quickly mastered the course and a year later decided to proceed to Göttingen to take a German medical degree. The description of the universities, the people he meets, the tours he

contrives are well recorded and give us an intimate knowledge of the times. To qualify in England it was necessary to remain at the same medical school for two years and it was this regulation which led him to enter Emmanuel College, Cambridge, in 1797. Two years later he completed the course and then proceeded to London, having inherited his uncle's small fortune.

In spite of the attention and time he devoted to his medical studies, Young had already made a name for himself in his original contributions to our knowledge of sound and light. While at St. Bartholomew's Hospital he published a very full account of the mechanism of the eye, first collecting all the known facts and then going on to give an explanation of accommodation, discovering astigmatism and then giving a theory of colour vision. Using an instrument called the Optometer, designed by Porterfield, Young was able to measure the " near " and " far " points for his own eye. The near point was not the same distance if he used the optometer for collecting a beam of light confined to a horizontal and then a vertical plane. This he accounts for by stating that the lens of his eye had a different curvature in a horizontal section than for a vertical section. He also adds the same effect could be produced if the lens in his eye were tilted with respect to the axis. Next by inserting a key ring into his eye, which was fortunately somewhat prominent, he measured the length of the eyeball and the curvature of the cornea. Moreover by immersing his eye in water he showed that the curvature of the cornea adds to the power of the lens. All these considerations are then advanced to show that accommodation must arise from the ability of the ciliary muscles to make the lens more powerful and that when we grow older the muscles are less efficient and so at great age the property is lost. The paper shows Young at his best ; first the essential theoretical relations are worked out, then an instrument perfected and measurements made. Next correct hypotheses are advanced backed by further experiments till the final explanation is given. Similarly in his explanation of colour vision he states that we are capable of feeling three distinct colour-sensations—red, blue and green, and it is different combinations of these primary sensations that account for the multiplicity of colours we observe. He describes the colour top by which mixtures of these colours can be demonstrated, and goes on to develop the " colour triangle." Finally he uses his theory to explain colour blindness in the particular case of his distinguished contemporary, John Dalton. The worth of this paper was recognized in Young's election to the Royal Society at the early age of 21.

Young took his M.B. degree at Cambridge in 1803, his M.D. in 1808 and, a year later, was elected to a Fellowship of the Royal College of Physicians. In 1811 he joined the staff of St. George's hospital, but

the summer of each year he spent at Worthing where he had a tolerably successful practice. On the whole he was disappointed with his work as a doctor, because he avoided drastic treatment so fashionable in those days and preferred to let nature have its own chance, which did not impress the public. Then, too, he was always more interested in collecting what was known in medicine, as is shown in his articles on the " Effect of Climate," his introduction to Medical Literature, the essay on consumptive disease, and the function of the heart and arteries. At the same time he developed the " Eriometer," which utilizes the phenomenon of diffraction to measure the size of small particles. Quite recently, Emmons has developed the modern clinical eriometer and he pays a tribute to Young's originality.

In the first ten years of the Nineteenth Century, Count Rumford founded the Royal Institution with the object of bringing artizans and eminent scientists together so that the general public could benefit from the new scientific knowledge. Sir Humphrey Davy and Thomas Young were appointed lecturers and through Davy's efforts royal patronage was secured and the success of the Institution assured. As a lecturer, Young was unpopular but the lectures which he subsequently published in 1807 alone establish Young's claim to fame. Sir Joseph Larmor considers them the greatest and most original of all general lectures on " Natural Philosophy and the Mechanical Arts." He adds in those days scientific people did not write numerous treatises, and into their work, as intended for permanence, they put their most sustained thought. We find that Young anticipated the work of Joule on the Conservation of Energy and investigtaed the elastic properties of metals, showing that in stretched wires the stress and strain are proportional, provided that the elastic limit is not exceeded. He then links this with the " sandblast effect " pointing out that " there is a limit beyond which the velocity of a body striking another cannot be increased without overcoming its resilience and breaking it, however small the bulk of the body may be." Young is in agreement with Rumford in asserting that heat is a mode of motion and uses the idea in explaining Herschel's discovery of infra-red radiation. Later on in the lectures he advances a theory of the tides and then compiles a " co-tidal " map for Great Britain, and by his tretament of tides in canals he sets the line for future fruitful research. At the end of Volume I of the Lectures are 43 plates, containing diagrams among which are some mechanisms which have become common features in most laboratories to-day, e.g. the chronograph (applied in the self-recording barometer) and the ripple tank. Probably more remarkable still is Young's geometrical construction for a refracted ray due to any incident ray falling on a spherical surface. Rediscovered by Amici, it is of fundamental importance in optical work, e.g. microscope

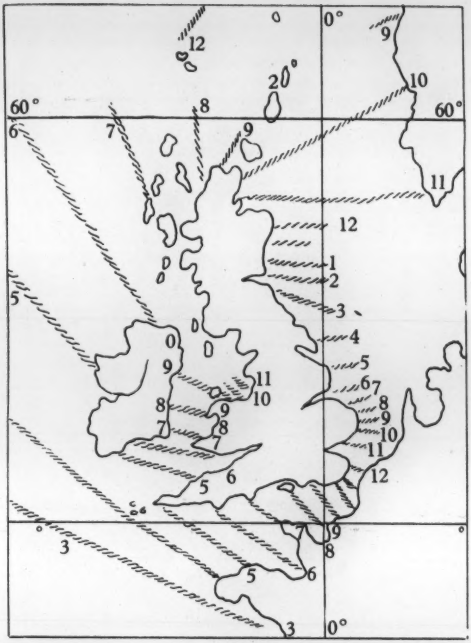

Fig. 2. Co-tidal Map. (*From Lectures on Natural Philosophy and the Mechanical Arts by Thomas Young, Vol. 1, Pl. 38, Fig. 521*)

objectives, and correcting defects of the image in any optical instrument. Finally, there is a catalogue of 450 quarto pages of works relating to Natural Philosophy, with Young's brief comments, showing that he must have read them all. This indicates the immense amount of labour involved and his thorough methods.

At the same time that Young was lecturing at the Royal Institution he became interested in the theory of light and colours upon which he comments—" though it did not occupy a large portion of my time, I conceived it to be of more importance than all I have ever done, or shall ever do besides." Following Huygens, he supposed that light energy was propagated in the form of waves and looked for proof in the phenomenon of interference, which is so conveniently demonstrated with

a ripple tank. When two equal series of water waves are generated from centres close to each other some parts of the surface will receive impulses in step, while others will be out of step. The former will be seen as maximum displacement, while the latter will show no displacement of the surface. It was typical of Young's genius that he realized how to obtain analogous results in light. The two sources of light must be identical and therefore must be obtained from a single source. In

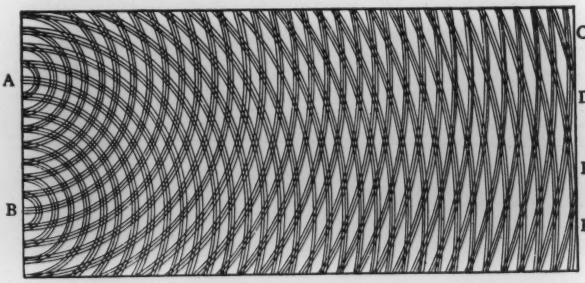

Fig. 3. Interference or superposition drawn for two sets of ripples originating at A and B. (From Sound Waves and their Uses by Alexander Wood, London, Blackie, 1930, p. 15, Fig. 16)

his first experiment he introduced between his eye and a narrow slit illuminated by sunlight a narrow strip of card about 1 mm wide, parallel to the slit. In the shadow equally spaced light and dark lines indicated the interference produced by equal portions of the beam on either side of the strip. Later he replaced the two beams by two narrow slits in the well-known interference experiment which now bears his name, and from the geometry of the apparatus he calculated the wavelengths of the principal spectrum colours. He went on to use the same principle to explain Newton's rings and the colours of thin films by the duplicated pulse. By the most ingenious interposition of a liquid of refractive index greater than glass of the lens used in producing Newton's rings, he changed the central spot from dark to light and accounted for the change of phase at internal reflection at a glass/air interface. He goes on to explain the colours produced when the ordinary and extraordinary rays traversing a crystal are examined by an analyser, stating that this again is an interference phenomenon produced by the difference in time for these rays to traverse the crystal. But here he was mystified by the nature of the vibration in a light wave, and although he hints that it may be partially transverse, he

argues too closely to the analogy of sound waves to realize that light is a totally transverse vibration.

Although he accounted for the phenomenon of diffraction by the interference of light direct to the point under observation and the light he supposed reflected from the edge of the obstacle, it remained for his younger contemporary, Fresnel, to arrive at the correct explanation. We ought not to leave this absorbing topic without a brief reference to the opposition Young met from Henry Brougham, later Lord Chancellor, who attacked his interference theory in the Edinburgh Review. In the first place Brougham criticized Young's theory as a direct attack on the outstanding work of Newton on the subject, and in the second place he calls in question the accuracy and reliability of Young's experiments and measurements. Although Young easily refuted the charges, Brougham was successful in influencing public opinion against him, possibly postponing the progress of optical science for twenty years (Larmor). It is only fair to say that Young's caustic comments on an early paper of Brougham's on mathematics was responsible for the animosity between them.

Fig. 4. Interference fringes in water. (From A Text Book on Light by A. W. Barton, London, Longmans, 1939, Pl. IV, Figs. 3 and 4)

Nowhere is Dr. Young's ingenuity so ably illustrated as in his calculation of the approximate size of molecules of matter. In a remarkable essay on cohesion, published in 1805, he linked the cohesive forces with those displayed in ebullition. This enabled him to derive a formula connecting such forces with the surface tension. He concluded that molecular forces extend over a region of diameter $6{\cdot}85 \times 10^{-4}$cms. His work was developed and extended by Laplace, although we had to wait till modern methods of atomic research revealed much greater information on the structure and size of molecules.

Other activities which engaged Young's attention in the next two decades concerned his contribution to the Encyclopaedia Britannica (1817–25), his association with the Admiralty, his secretaryship of the Board of Longitude and editorship of the Nautical Almanac, his work on weights and measures as well as his incursion into life assurance. Napier, the Editor of the Encyclopaedia, relied on Young for articles on

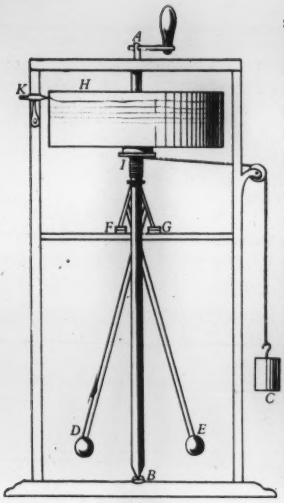

Fig. 5.
Forerunner of Recording Barometer

such subjects as Cohesion, Chromatics, Egypt, Hydraulics, Tides, Annuities, Bathing, Bridges, Carpentry, Integrals, Herculaneum, Languages, Life Preservers, Road making, Steam Engine and Weights and Measures. With 45 biographies his 61 articles comprise 380 quarto pages. With the Admiralty Young was chiefly concerned with checking the design of ships and polar exploration. His association with the Board of Longitude and the Nautical Almanac brought him severe criticism from the founders of the Royal Astronomical Society, but there is no doubt that he was the best secretary the Board ever had, while his work with the Almanac has been fully vindicated. He was medical adviser and referee for the Eagle Star Assurance Company. Here he made a complete study of mortality tables and derived his own formula.

Finally, a tribute must be paid to Young's lifelong devotion to the study of languages, culminating in his interpretation of the Egyptian Hieroglyphics. He was fortunate to have access to a number of inscriptions including the famous Rosetta Stone. This contained inscriptions in Greek, demotic and hieroglyphics of a decree of Ptolemy Epiphanes recorded in 195 B.C. Young showed that the demotic was in part hieroglyphics adapted to a running hand, secondly a frame or cartouche distinguished proper names and that words therein were phonetic. These rings, he stated, were around the names of persons recorded on the monuments founded by them, and not the Gods in whose honour they had been built ; he found the signs which indicated whether the person was male or female. There is no doubt that Young's application of the phonetic principle to Egyptian hieroglyphics was the key which enabled Champollion, the distinguished French scholar, to formulate the accepted system of grammar and decipherants used up to the present.

As a person, Young had full zest for life, though he was naturally somewhat reticent. Although Foreign Secretary of the Royal Society for twenty-five years and a member of the Council for a longer period, he rarely made a speech. He did not appreciate other people's

difficulties and attributed his own success to steady application. Here, his remarks on education are indicative : " Masters and mistresses are very necessary to compensate for want of inclination and exertion, but whoever would arrive at excellence must be self taught." Always critical of those working in his own fields he could be caustic and biting when the occasion required. He was jealous of the good name and standing of the Royal Society which accounts for his conflict with those who formed the Royal Astronomical Society, expecting it to be an unnecessary rival. Again, he was an apostle of freedom, rejecting any grants from the State for the advancement of science. His home life was singularly happy ; he married Miss E. Maxwell when he was 31, and she lived another thirty years after his death in 1829. It was through her help and advice that Dean Peacock was able to publish in 1855 the four volumes on Thomas Young. Strictly speaking, three volumes of these are Young's original works and the fourth Peacock's Life of Young.

We may conclude that the words on Dr. Young's monument in Westminster Abbey are a fitting testimony to his remarkable versatility and genius—" Fellow and Foreign Secretary of the Royal Society, Member of the National Institute of France, a man alike eminent in almost every branch of human learning . . . he first established the undulatory theory of light and first penetrated the obscurity which had veiled for ages the hieroglyphics of Egypt."

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1. *A Course of Natural Philosophy and the Mechanical Arts.* 1807. T. Young. Kelland's new edition, 1845.
2. *Miscellaneous Works of Dr. Thomas Young*, by Peacock and Leitch. 1845. Pub. Murray.
3. *Young, Philosopher and Physician*, by Oldham, 1933. Pub. Edward Arnold.
4. *Thomas Young, Natural Philosopher*, by Wood and Oldham, 1954. Published Cambridge University Press.
5. *The Rosetta Stone.* Printed by order of the trustees of the British Museum.

Figs. 3 and 4 are reproduced by courtesy of the Cambridge University Press.

THE GRADUATESHIP EXAMINATION, 1954

The Institute's Graduateship Examination was held from June 21 to 25. Written papers were taken at the Institute's House, the College of Technology, Birmingham, and Paisley Technical College ; the practical examination was held at The Polytechnic, Regent Street, London.

Seventy-seven candidates had been accepted for the examination but later twenty-three withdrew, mainly requesting a transfer of their entries to next year. Of the remaining fifty-four candidates who sat, all except two held qualifications which entitled them to exemption from all except two papers of the examination. The following nineteen candidates satisfied the examiners in the papers they were required to take and now comply with the academic requirements for election to Graduateship :—

R. M. Absalom (*Harwell*)
G. R. Boney (*Mitcham*)
L. R. Day (*Grays, Essex*)
I. D. Dodd (*Pontypridd*)
W. J. Gunning (*Chadderton, Lancs.*)
M. E. Harper (*Crawley*)
B. Henderson (*Carlisle*)
T. K. D. Hindley (*Spondon, Derbyshire*)
P. N. Holt (*Manchester*)
D. Jackman (*Mitcham*)
M. Kirton (*Harwell*)
D. W. Lewin (*London*)
T. I. Putner (*Sydenham*)
J. F. Sayers (*Barnehurst*)
D. Shaw (*Sheffield*)
A. Swindells (*Newport, Mon.*)
R. P. Wilkinson (*Cheltenham*)
R. M. Wood (*Birmingham*)
A. M. H. Wright (*Gloucester*).

(A further candidate satisfied the examiners in the required papers in physics but failed the paper in General Education which must be taken by all candidates who do not already hold a qualification satisfying the Institute's membership regulations relating to general education.)

The performance of D. Shaw was outstandingly good and the examiners have decided that, in accordance with Regulation 10 governing the examination, he may later apply for Associateship on the basis of the period of experience required of honours graduates.

Of the successful candidates, thirteen already hold university degrees such as the General degree of the University of London at pass standard, and the remaining six Higher National Certificates in Applied Physics.

The examiners were Professor A. M. Tyndall (Physics II and More Advanced Physics), Professor F. A. Vick (Physics I and III), Mr. A. E. De Barr (Electronics and High Vacuum Technology), Dr. J. Topping (Mathematical Physics, Mathematics I and II), Mr. E. D. Van Rest (Statistics) and Mr. N. Clarke (General Education). The examiners for the practical examination were Mr. A. E. De Barr and Mr. J. Yarwood.

The detailed results are :—

	No. of candidates	*Passes*
Physics I (General physics and acoustics) ...	26	12
Physics II (Heat and Optics)	27	8
Physics III (Electricity and Magnetism) ...	2	0
Mathematics I	7	4
Mathematics II	1	0
Mathematical Physics	1	0
More Advanced Physics	28	14
Electronics	19	13
High Vacuum Technology	1	1
Statistics	1	1
Practical Examination	2	1
General Education	11	7

An analysis of the results in terms of the academic status of the candidates is :—

	No. of candidates	*Passes*
(*a*) *Candidates required to take only two papers*—		
Holders of a degree (London General degree at pass standard, Ordinary degrees, etc.)	28	13
Holders of a Higher National Certificate in Applied Physics	24	6
(*b*) *Other Candidates*	2	0

CORRESPONDENCE

My I comment on the review of my book, *Properties of Matter*, published in the June *Bulletin*. Surely it is not the function of a reviewer to state whether or not a satisfactory course could be based on the book, even though he feels unable to do so himself, since it is certain that other teachers can and are doing so. The book had already been reprinted four times before the present edition appeared. The reviewer's stated criticism is levelled at Chapter II and his most serious objection is to "the development of circular motion in a statical manner." Should the earth suddenly change its speed of spin I suggest that the new weights will be used in statical problems without any flinching. That the cyclist sitting stationary relative to his bike, or to a van, should do a similar thing is not creating difficulties for the student. Twenty-five years' experience with a very considerable number of good students has taught me the value of starting with the student as centre and later discussing (say, when Gravitation is studied) the two methods of approach. Such a treatment leads to a more flexible outlook on the part of the pupil and prepares him better for future work in physics.

The reviewer should not be surprised that some Ordinary level physics has been omitted from a book written for Advanced level work, particularly when keeping the price of a book down is an important consideration these days. Incidentally, there are three references to the relations between linear and circular motion and 73 examples come from sources other than the N.U.J.B.

Your reviewer makes no reference at all to what is a distinctive feature of the book compared with other books on Properties of Matter, namely the detailed and carefully tested experimental work.

The last paragraph of the review gives the impression that the book is carelessly written. This is far from the truth because it has been carefully and thoroughly revised by myself and by others whose competence is not in doubt.

H. STEELS.

REPORTS OF BRANCH AND GROUP MEETINGS

Education Group Summer Meeting

For its Summer Meeting this year the Education Group paid a visit on June 12 to the Royal Holloway College, by the courtesy of the Principal, Dr. E. C. Batho, and Professor S. Tolansky, F.Inst.P., F.R.S.

Prof. Tolansky welcomed the visitors and gave a brief talk on the Physics Department. After a few historical remarks he said that the

last few years had seen a notable increase in the number of students taking physics at the College and he thought it was very important that this trend should continue in view of the deplorable lack of competent physics teachers in many girls' schools. As a result of his recent experience he was confident that the commonly held view that in general girls did not do well at physics was true only because of the lack of good teaching in the schools. He concluded with a short explanation of the research activities in the Department—which also have greatly expanded in recent years. Practically all this work was concerned with the investigation of the microtopography of surfaces, using various new techniques.

This preliminary talk was followed by a tour of the College buildings, particularly the Dining Hall, Kitchens, Picture Gallery and Library. Miss A. R. Dickson, the Residence Officer of the College, who acted as guide, greatly added to the enjoyment of the party by her lively account of the history of the college.

The meeting was very interesting and enjoyable and the Group is grateful to all those members of the College who gave time and trouble to make it so.

F.Y.P.

Manchester and District Branch Summer Meeting

The Summer meeting of the Manchester and District Branch was held at the Christie Hospital and Holt Radium Institute on the morning of Saturday, the 29th of May, and was attended by about 70 members and their guests.

The principal items of interest were the 20 MeV Betatron and the 4 MeV Linear Accelerator which have recently been installed for the production of high energy X-radiation for the treatment of cancer. In addition, a tour was arranged which included the departments concerned with biological physics, health physics and the monitoring of radiation hazards, the therapeutic uses of radioactive isotopes, and the techniques of X-ray therapy, as well as the " flying spot " microscope which is in course of development.

Our thanks are due to the Chairman of the Branch, who is a member of staff of this hospital, and to his colleagues, for arranging a most enjoyable and efficiently organized visit.

REVIEWS OF BOOKS

The Electromagnetic Field in its Engineering Aspects. By G. W. CARTER. (London : Longmans, Green & Co. Ltd.). Pp. 360. Price 35s.

The many specialized branches that have now developed under the general title of electrical engineering make it essential to include a thorough background of physics in degree courses, and especially in courses for students of honours standard. This has to be done concurrently with technological studies which have their own major interest for engineering undergraduates, and it leads to the demand for works combining basic physics illustrated by applications of engineering interest, a task that has been undertaken by many authors, but nowhere better than in this work on basic field theory. Courses under this title are now beginning to appear in engineering syllabuses, and it has been suggested that field theory rather than circuit theory might even form the basis for electrical courses.

Professor Carter adopts the rationalized MKS electromagnetic system of units for very good reasons which he states clearly and briefly, and the basic laws (e.g., Biot-Savart theorem) are adequately proved and not merely stated. The distinction between B and H is well treated in chapters 6 and 7, and in a manner which will be appreciated by the student reader. The equivalence of a current loop and a magnetic dipole is demonstrated, with subsequent treatment based mainly, but not exclusively, on the magnetic effects of a current. The magnetization curve for iron is explained in terms of the domain theory, making it possible to give a very simple statement on magnetostriction.

In chapter 8, the author discusses some of the confusing " problems" in electromagnetic theory arising, for example, from arguments as to whether or not the magnetic field (or " lines ") surrounding a bar magnet rotates as the magnet is spun about its axis. The concluding chapters on alternating field phenomena in conductors, propagation of electromagnetic wares, energy flow, and the implications of relativity theory, will prove stimulating to teachers and students alike. For example, the discussion on Slepian's conception of energy flow in chapter 13 indicates the type of speculation that could be developed in tutorial discussion on these later chapters.

Criticism of such a thoughtful work is mainly a matter of preference on points of detail, and suggestions for an extended treatment of some sections. The use of the same letter in light and heavy type presents practical difficulties in speech and handwriting, although it is a recognized printing technique. In the early chapters, topics such as the principle of guard rings, and the method of images, are of sufficient

importance to merit their own sections rather than incidental mention—the guard ring C of figure 3.27 is not mentioned in the adjoining text. In chapter 11, alternating fields are introduced by using "symbol j to denote phase," and its abrupt appearance in equation 8 . 7 . 1 . is not really adequate treatment for the student reader.

The subject matter of this book should be covered by every honours course in electrical engineering, and one only regrets that it does not seem practicable to do this before technological studies commence. The book is well printed, with clear illustrations, and the questions at the end of each chapter are well chosen to amplify the text and stimulate tutorial discussion.

F. M. BRUCE.

A Concise History of Mathematics. By DIRK J. STRUIK. (London : G. Bell and Sons Ltd.). Pp. 299. Price 14s.

It is surprising how much Professor Struik has managed to get into his concise history of Mathematics. The selection of material for any historical account of a science is of necessity rarely purely objective but influenced by the author's likes and dislikes and his particular specialized interests. Professor Struik's choice has been most happy. Especially he has not devoted too much time and paper to the earlier developments of the subject nor concentrated too much on the work and lives of the great "classical" mathematicians of antiquity—too often histories over-emphasize their value and place them in the wrong perspective.

Much of the material has come on the author's own admission from sources that were "too often second or third hand" but there appears no glaring inaccuracy in spite of this. Particularly attractive in this respect is his honest account both of the personalities of a development and of the social and cultural setting in which it took place. Mathematics even "speculative mathematics" has been influenced by the many factors of environment and by the discoveries in many other fields. In return it has enriched many of the fields from which it has developed and contributed also to the philosophy and thought of many movements.

This book of Professor Struik's by giving details of its discoveries and its place in the discoveries of other sciences is a valuable aid in making the mathematician more conscious of the "reasoning" and less anxious to seek only the technique of his subject. The author comments that in America "the mathematics we teach our present day engineers and technicians is still of the do such and such type without much attempt at rigorous demonstration. Algebra is still being taught in many high schools as a set of rules rather than a science of deduction." Substitute Grammar School and Technical Institute for high schools

and add physicist to engineer in this quotation and his statement applies as well to England as America. A copy of this book in the library might be useful as a curative for this present-day tendency of regarding the subject only as a utilitarian science, the servant of the others, instead of being sometimes (to quote Professor Bell, one of Professor Struik's countrymen) their Queen.

A. K. SMETHAM.

Introduction to Typography. By OLIVER SIMON. (London : Penguin Books Ltd., in association with Faber and Faber Ltd.). Pp. ix + 117. Price 3s. 6d.

Evidence of the increased interest in the design and production of books seems to be provided by the fact that the original version of this book, written by a typographer of repute and published by Faber and Faber in 1945, reached a fifth impression last year. The revised edition, made available at a most reasonable price by Penguin Books, will stimulate this interest. The quantity of material in each edition is roughly equal although some changes have been necessary ; some illustrations of title-pages have been scaled down very carefully for the smaller pages of this edition. Since the Penguin edition contains fewer pages than normal Pelican books priced at 3s. 6d. it has been possible to select an extremely good paper. This feature, together with the care taken at the author's own press, have resulted in the production of an extremely legible book.

The contents include concise essays on rules of composition, choice of type face, setting of text, choice of paper, binding, dust jackets and related topics. Although most readers of the *Bulletin* may not wish to study all these topics they would nevertheless be helped to a further appreciation of books. Such increased interest, aided by reference to the useful hand-list of books provided, would gradually play its part in the development of typography.

R. HARESNAPE.

NOTICE TO MEMBERS

Expulsion of a Fellow

In accordance with the provisions of Article 12 of the Articles of Association of the Institute, Mr. Christopher Candler has been declared by the Board to be no longer a Member of the Institute.

Messrs. Barr and Stroud Limited, Anniesland, Glasgow, require the services of one or two young men, preferably with a university degree in Engineering or Physics and with some industrial experience.

Applicants must have a sound technical and scientific education such as would be required to carry out research and development work associated with scientific instruments of a wide variety.

The work is interesting and offers scope to men of outstanding ability.

Applications should contain full particulars, including age, nationality, school and college education, industrial experience, also salary required. Replies should be addressed to the Secretary.

Instrument engineer required to take charge of instrument department of large rayon yarn producing factory. Duties will include the preparation of instrument specifications for new plant and influencing the application of instrumentation to existing plan. Applicants should be corporate members of an appropriate institution or have an appropriate university degree and have had experience of chemical plant instrumentation. Experience with electronic equipment would be an advantage. Age 30–40 years. Pension scheme. Salary according to qualifications and experience. Applications which will be treated confidentially should state age, qualifications, experience and addressed to Personal Manager, British Enka Limited, Aintree, Liverpool, 9.

Woolwich Polytechnic, London, S.E.18. Principal : J. S. Tait, Ph.D., B.Sc., A.R.T.C., M.I.E.E., A.M.I.Mech.E.

Applications are invited from Honours graduates and from students who entered for their final Honours (Special) degree examination in June last for **Research Studentships in Physics.** The studentship will normally lead to the Ph.D. degree (Internal) of the University of London. Its value is £350 p.a. and is tenable for two to three years. Particulars and application form from Clerk to Governors.

The Medical Research Council have a vacancy at the National Institute for Medical Research, Mill Hill, London, N.W.7, for a **physics graduate** (male or female) to work in the electron microscopy laboratory of the Biophysics Division. The work involves collaboration with biologists. Previous experience is not essential. The appointment will be for three years in the first instance (subject to review after one year). The commencing salary will be determined by qualifications and experience.

Applications, giving full personal particulars (including details of academic career and references to any scientific publications), and the names of two professional referees, should be sent to the Director.

Distillers Company Limited are seeking an **instrumentation engineer** for one of their chemical factories in North East England. Duties will involve organizing maintenance of instruments in the factory and advising on installation and use of instruments in chemical process work. Age 30/35. Applicants should have a degree in chemistry, chemical engineering or engineering and must have a knowledge of chemical plant instrumentation. Salary will depend on qualifications and experience. Apply : Staff Manager, The Distillers Company Limited, 21 St. James's Square, London, S.W.1. Quote Ref. BIS. 354.

Kingston upon Hull Education Authority. Municipal Technical College, Principal : Emlyn Jones, M.Sc., F.R.I.C. Required to commence duty in September, 1954, or as soon as possible thereafter, teacher (Assistant Grade B) for physics to final B.Sc. standard and to assist in the development of postgraduate short courses in Applied Physics. Candidates should have a good honours degree. Experience in some branch of applied physics is desirable. Salary : (at present) £490 × £25 to £765 (plus additions for suitable teaching, professional and industrial experience).

Further particulars and application forms, to be returned by August 24, will be supplied by the Chief Education Officer, Guildhall, Kingston upon Hull.

Vacancies exist for **Development Engineers** to work on new ideas in electrical and mechanical industrial instruments and servo mechanisms. A Degree in Physics or Engineering is desirable, with sound experience in fundamental theory and design. Write giving full details of experience, age and salary, to Box A.V.64, The Institute of Physics, 47 Belgrave Square, London, S.W.1.

National Coal Board at their Central Research Establishment, Isleworth, Middlesex, carry out research on problems of coal winning and other underground activities. The field covered at present is broadly :—

(*a*) Studies of the mechanical properties of coal ;
(*b*) Technical methods of coal winning ;
(*c*) Mechanical engineering and metallurgical problems ;
(*d*) Strata control and underground transport of coal by conveyors ;
(*e*) Mine conditions, including dust, methane, temperature and humidity ;
(*f*) Electrical control and instrumental problems.

Applications are invited for the following superannuable posts :—

Principal Scientist (Physicist), salary range £1,895–£2,195 inclusive, to take charge of work of (*e*) and (*f*) above. (*Reference No. TT/807.*

Senior Scientist (Mechanical Engineer), salary range £1,595–£1,895 inclusive, to take charge of (*a*), together with a group concerned with theoretical work. (*Reference No. TT/808*).

Senior Scientist (Physicist or Mathematician). Salary range as above to take charge of (*c*) above. (*Reference No. TT/809*).

Scientist Grade I (Physicist or Light Electrical Engineer), salary scale/range £1,232–£1,650 inclusive, to lead a group engaged on research on electronic and electrical instrumentation for use for laboratory measurements and under conditions in mines. (*Reference No. TT/810*).

Consideration will be given only to candidates having first or good second class honours degrees or equivalent professional qualifications and having a proved record both of achievement in research and ability to lead a team.

Applications should be sent to Dr. L. C. Tyte, Director, Central Research Establishment II, c/o National Coal Board, Hobart House, Grosvenor Place, S.W.1, giving full particulars (in chrononological order) of age, education, qualifications and experience (with dates) *and marking envelope with the relevant TT Reference Number quoted above.* Original testimonials should NOT be forwarded. Closing date August 21, 1954.

ASSISTANTS

Assistant required, National Service completed, for research in packaging problems of behaviour of materials under shock. Interest in properties of matter and a familiarity with electronic circuits useful. G.C.E. Advanced level in physics and mathematics preferably with laboratory experience, £275–£475. Application forms from Secretary, Printing, Packaging and Allied Trades Research Association, Randalls Road, Leatherhead, Surrey.

Research and Technical Assistants (male or female) required for work concerned with physics and chemistry of light sources. Advanced level of G.C.E. required and intention to complete degree or equivalent qualification in physics, electrical engineering or chemistry. Day time education facilities. Minimum of £416 per annum for applicant at intermediate B.Sc. standard. Five-day week, modern laboratories. Apply Personnel Manager, Thorn Electrical Industries Ltd., Gt. Cambridge Road, Enfield.

Technical Assistants required in London area for development work on a wide range of industrial instruments. Applicants should hold the Higher National Certifictae in Engineering or Physics with preferably, but not essentially, some experience in experimental work in physics or electronics or instrumentation generally. Write stating age, experience and salary required, to Box AV.65, The Institute of Physics, 47 Belgrave Square, London, S.W.1.

Imperial Chemical Industries Ltd., Billingham Division, has vacancies for physicists and chemists for **assistant technical officer** posts in their Research Laboratories. Candidates should be not more than 27 years of age and should have at least the Inter-B.Sc. qualification. Salary will depend on qualifications and experience. Write giving brief details of career to The Staff Manager, Imperial Chemical Industries Ltd., Billingham Division, Billingham, Co. Durham, quoting reference P.1.

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